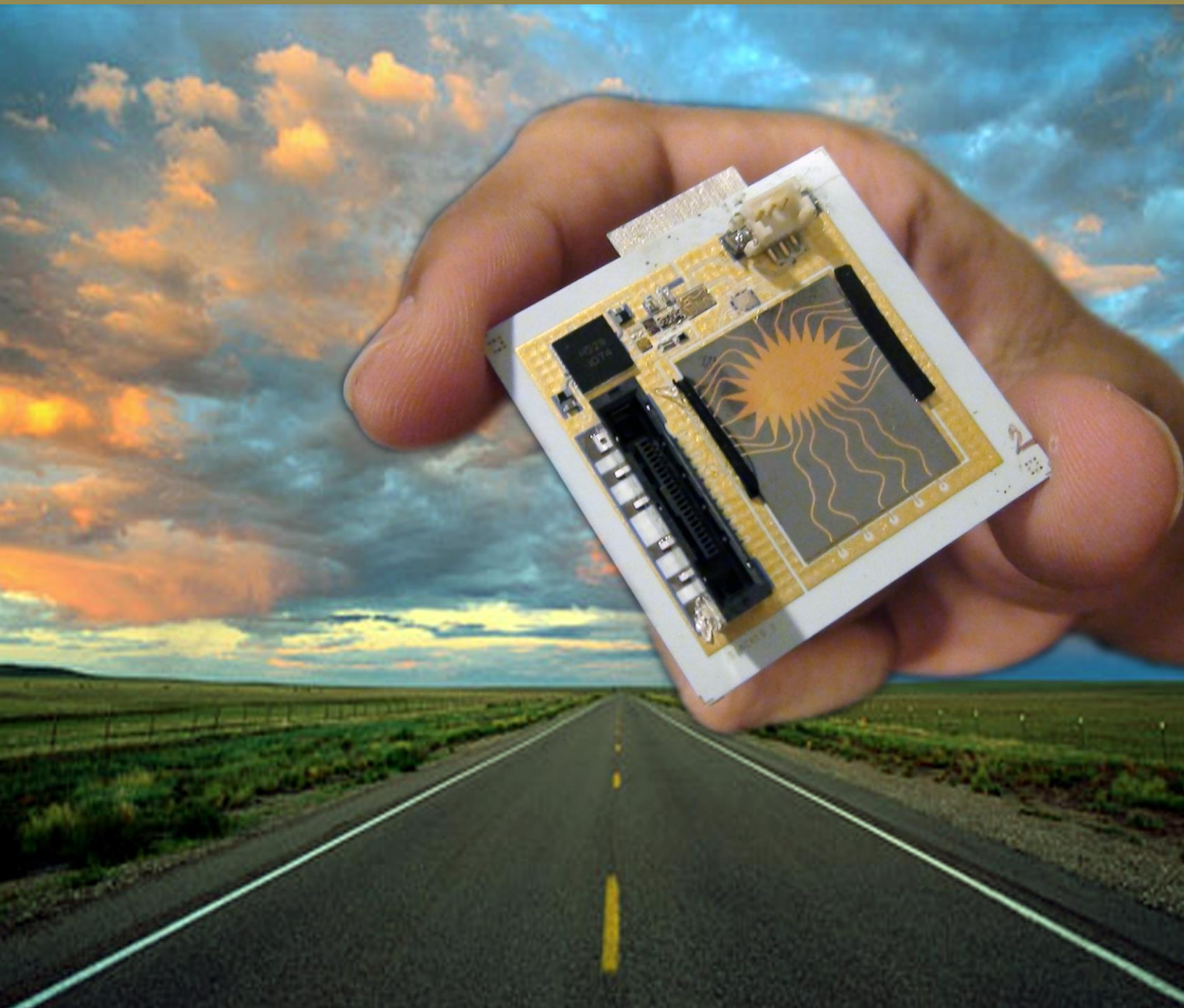




RESEARCH CENTRE FOR INTEGRATED MICROSYSTEMS (RCIM) REPORT

January 1, 2013 – December 31, 2013

**Department of Electrical & Computer Engineering
University of Windsor**



Director's Report for 2013

It gives me a great pleasure to present the 2013 annual report of the Research Centre for Integrated Microsystems (RCIM), at the Department of Electrical and Computer Engineering, University of Windsor. RCIM faculty members and their students have been conducting leading edge research, in various areas of integrated microsystems with applications in the fields of digital signal processing, computer vision, automotive electronics, encryption and RFID for security application. RCIM currently has 10 faculty members, 21 Ph.D., 14 M.A.Sc. students, one Post Doctoral Fellow and two visiting professor from National University of Defense Technology from China who are actively pursuing research in this facility.

In 2013 RCIM faculty members graduated 8 MA.Sc. and 2 Ph.D. students. During the same year, our members received more than \$2,637,000 in grants, donations and contracts, and the results from their research works generated 36 papers published in peer reviewed Journals and top tier Refereed Conferences as well as filing four US patents. Also, RCIM members delivered 9 research seminars during 2013 and our members were active in organizing various international conferences including: ISSCS, and IEEE-MWSCAS few to mention. They have also served on the editorial board of various journals.

On behalf of the RCIM faculty and student members I would like to express our sincere thanks for the continued support we have been receiving from the President, Dr. Alan Wildeman, Vice President Research , Dr. Michael Siu, and the Dean of Engineering, Dr. Mehrdad Saif of the University of Windsor. Finally, we are thankful to CMC Microsystems for providing RCIM with state-of-the-art facilities allowing us to design advanced integrated Microsystems and for subsidizing our IC fabrication costs.

Majid Ahmadi, PhD, C.Eng., FIET, FIEEE

Director of RCIM

University Professor

I. RCIM Areas of Specialization

The Research Centre for Integrated Microsystems within the Department of Electrical and Computer Engineering in the Faculty of Engineering at the University of Windsor has been conducting research in the following areas:

1. MICROELECTRONICS, including:

- High Speed DSP Systems
- Computer Arithmetic
- Encryption
- Radio Frequency Identification (RFID)
- Testing of Mixed Signal Integrated Circuits
- Field Programmable Chips and Systems
- CMOS and Nanoelectronic circuits design

2. MICROELECTROMECHANICAL SYSTEMS (MEMS), including:

- Sensors and Filters
- Capacitive Microphones and 3-D Acoustical Sensing
- Electromagnetic Microactuators
- Acousto-Magnetic Transducers
- Optical Switching MEMS
- Automotive Sensors
- Customs MEMS Sockets
- Micro power Generators
- Atomic Force Microscopy
- MEMS RADAR

3. DIGITAL SIGNAL PROCESSING AND COMMUNICATION, including:

- Algorithms
- Massively Parallel Arrays and Special Architectures
- Computer Vision and Image Processing
- Pattern Recognition and Document Analysis
- Network Security Management
- Network Management

These projects vary from fundamental pre-competitive research to mission-oriented research, technology transfer and prototype development. We are particularly interested in areas requiring advanced signal processing systems embedded in complex integrated microsystems.

II. RCIM MEMBERS

(A) *Faculty Members:*

Eleven faculty members in Electrical and Computer Engineering conduct research and supervise graduate students as members of the Research Centre for Integrated Microsystems. The day-to-day operation of the Centre is administered by the coordinator of the RCIM, who provides training for new graduate students on how to use the facilities, as well as maintaining the hardware and CAD tools used by the RCIM members.

1. Dr. Majid Ahmadi, University Professor (Director, RCIM)
2. Dr. Shervin Erfani, Professor
3. Dr. Chunhong Chen, Professor
4. Dr. Esam Abdel-Raheem, Associate Professor
5. Dr. Sazzadur Chowdhury, Associate Professor
6. Dr. Roberto Muscedere, Associate Professor
7. Dr. Mohammed Khalid, Associate Professor
8. Dr. Huapeng Wu, Associate Professor
9. Dr. Mitra Mirhassani, Associate Professor
10. Dr. Rashid Rashidzadeh (Adjunct Professor and RCIM Manager)
11. Dr. William C. Miller (RCIM Director Emeritus)

(B) Student Members:

RCIM has a strong track record of training outstanding graduate students. Our students have been very successful in finding employment in academia, industries as well as admissions to PhD programs in premier institutions in Canada and USA.

RCIM Students Graduated in 2013				
First name	Surname	Program	Supervisor(s)	Thesis
Wangchen	Dai	M.A.Sc.	Dr. H. Wu	Efficient finite field computations for elliptic curve cryptography
Ran	Xiao	M.A.Sc.	Dr. C. Chen	Single electron devices and circuit architectures: Modeling techniques, dynamic characteristics and reliability analysis
Farinoush	Saffar	M.A.Sc.	Dr. Ahmadi and Dr. Mirhassani	A Mixed Signal Feed Forward Neural Network Architecture Using High-Resolution Multiplying D/A Conversion
Krunal	Jetly	M.A.Sc.	M. Khalid	An Experimental Comparison of Store-and-Forward and Wormhole Routers on FPGAs
Babak	Zamanlooy	Ph.D.	Dr. Mirhassani	Mixed-Signal VLSI Implementation of CVNS Artificial Neural Networks
Jonathan	Aguire	M.A.Sc.	Dr. Chowdhury	A 5 Meter Range Non-Planar CMUT Array for Automotive Collision Avoidance
Sabrina	Zereen	M.A.Sc.	Dr. Chowdhury	An FPGA Based Controller for a MEMS Tri-mode FMCW Radar
Dan	Macdonald	M.A.Sc.	Dr. R. Muscedere	Hardware JPEG compression
Soheil	Servati Beiragh	Ph.D.	Dr. R. Muscedere	Hardware Accelerated Text Display
Soke	Onyemelukwe	M.A.Sc.	Dr. S. Erfani	Evaluation of On-Demand Routing in Mobile Ad Hoc Networks and proposal for a Secure Routing Protocol

Current RCIM Students				
First name	Surname	Program	Supervisor	Thesis
Shoaleh	Namin	Ph.D.	Dr. H. Wu and Dr. Ahmadi	Power efficient finite field multipliers for elliptic curve cryptography
Bingxin	Liu	M.A.Sc.	Dr. H. Wu	TBA – Working in the area of efficient implementation of public key cryptography
Raqib	Asif	M.A.Sc.	Dr. H. Wu	TBA – Working in the area of low complexity of finite field multipliers
Ruiqing	Dong	M.A.Sc.	Dr. H. Wu	TBA – Working in the area of Network security
Hend	Alhajsalem	Ph.D.	Dr. H. Wu and Dr. Khalid	TBA – Working in the area hardware design space exploration for Elliptic Curve Cryptography algorithms
Shaeera	Shurva	M.A.Sc.	Dr. M. Ahmadi Dr.R. Rashidzadeh	Indoor Position Location System
Faroq	Awin	Ph.D.	Dr. M. Ahmadi and Dr. Abdel-Raheem	Efficient and Improved Cooperative Spectral Sensing for Cognitive Radios
Abbas	Elazhari	M.A.Sc.	Dr. M. Ahmadi	Recognition of Human Face from Low Resolution Images
Soodeh	Nikan	Ph.D.	Dr. M. Ahmadi	Recognition of Human Faces under Degradation Conditions
Parham	Hosseinzadeh Namin	Ph.D.	Dr. M. Ahmadi and Dr. Muscedere	VLSI Design of Low Power Crypto System
Morteza	Lalmazlounian	Ph.D.	Dr. Abeul-Kader and Dr. M. Ahmadi	Economical Production and Remanufacturing System under Uncertainty
Niloufar	Salehi	Ph.D.	Dr. Boufama and Dr. M. Ahmadi	Computer Vision sand Image Proc

Current RCIM Students				
First name	Surname	Program	Supervisor	Thesis
Salem	Alsaid	Ph.D.	Dr. Khalid and Dr. Abdel-Raheem	TBA – Working in the area of automotive embedded systems
Jenita	Rajamanickam Manokaran	M.A.Sc	Dr. Khalid	TBA – Working in the area of FPGAs architecture and CAD
Ian	Janik	M.A.Sc	Dr. Khalid	TBA – Working in the area of High Level Synthesis for FPGAs
Qing	Tang	M.A.Sc	Dr. Khalid	TBA – Working in the area of High Level Synthesis for FPGAs
Asmeen	Kashif	Ph.D.	Dr. Khalid	TBA – Working in the area of High Level Synthesis for FPGAs
Weiyang	Zeng	Ph.D.	Dr. Khalid and Dr. Chowdhury	TBA – Working in the area of automotive embedded systems
Rani	Gnanaolivu	PDF	Dr. Mirhassani	Resource Management using Particle Swarm Optimization
Bahar	Youssefi	Ph.D.	Dr. Mirhassani	Insect Based Vision Sensor
Yuan	Jing	M.A.Sc.	Dr. Mirhassani	Digital Recurrent Neural Networks
Iman	Taha	Ph.D.	Dr. Mirhassani	Multi Data Rate Transceiver Chipset for RF Serial Link.
Yuqi (Raymond)	Jiang	M.A.Sc.	Dr. Mirhassani	TBA
James	Tian	Ph.D.	Dr. Mirhassani	TBA
Weiyang	Zeng	Ph.D.	Dr. Chowdhury	Intelligent Vehicle safety system based on a fault-tolerant bus and data fusion
Rayyan	Manwar	Ph.D.	Dr. Chowdhury	MEMS based ultrasonic probe for medical diagnostic imaging
Iftekhar	Ibne Basith	Ph.D.	Dr. Rashidzadeh Dr. Abdel-Raheem	Contactless Test Access Mechanism for 3D ICs
Esrafil	Jedari	Ph.D.	Dr. Rashidzadeh Dr. Saif	TSV Fault Detection in 3D ICs
Ali	Attaran	Ph.D.	Dr. Rashidzadeh Dr. Muscedere	Chipless Radio Frequency Identification
Mohan	Thangarajah	Ph.D.	Dr. Rashidzadeh Dr. Erfani	Energy Scavenger using MEMS Actuator at the Resonant Frequency
Mohammad	Supon	Ph.D.	Dr. Rashidzadeh	TBA
Zheng	Gong	M.A.Sc	Dr. Rashidzadeh Dr. Abdel-Raheem	Through Silicon Via (TSV) Equivalent Circuit Model using 3D Full-wave Analysis
Zheng	Wu	M.A.Sc	Dr. Rashidzadeh Dr. Muscedere	A Robust RSSI Based System for Indoor Location Positioning and Tracking
Ali	Dianat	M.A.Sc	Dr. Rashidzadeh Dr. Muscedere	A Resonant Based Test Methodology for Capacitive MEMS

Current RCIM Students				
First name	Surname	Program	Supervisor	Thesis
Vladimir	Mashkovtsev	M.A.Sc	Dr. Rashidzadeh Dr. Abdel-Raheem	A DLL based Test Solution for 3D ICs
Khaja	Shazzad	Ph.D.	Dr. Abdel-Raheem and Dr. Tepe	Energy Efficient Reconfigurable MAC Protocol for Underwater Sensor Networks

Graduate Student Summary

Currently, RCIM faculty members are supervising 14 M.A.Sc. and 21 Doctoral students. Most of the RCIM graduate students were recipients of various scholarships from NSERC, OGS, and the University of Windsor as well as some from their governments.

III. PROFESSIONAL ACTIVITIES of RCIM FACULTY MEMBERS

Dr. M. Ahmadi:

- Fellow of IEEE
- Fellow of IET
- Associate Editor for Pattern Recognition Journal
- Technical Program Chair for the 2013 International Symposium on Signals, Circuits and Systems, Iasi, Romania
- Member of the Steering Committee for IEEE Midwest Symposium on Circuits and Systems
- Member of Board of Directors for the Green Auto Power Train
- PhD External Examiner for Waterloo University and Concordia University.

Dr. M. Khalid:

- Served as a reviewer for IET CDT and IET Electronic Letters
- Served as a reviewer for Research Grants Council of Hong Kong
- Served as PhD external examiner for Queens University

Dr. E. Abdel-Raheem:

- Associate Editor for Circuits, Systems, and Signal Processing.
- Associate Editor for Int. J. of Computing and Digital Systems.
- Editorial Board member, IET Signal Processing.

Dr. H. Wu:

- Served as an associate editor for IEEE Trans Computers
- Served as a reviewer for several other IEEE transactions

Dr. S. Chowdhury:

- Reviewer, Elsevier, Communications in Nonlinear Science and Numerical Simulations
- Reviewer, IEEE Sensors Journal
- Reviewer, IEEE Transactions on Circuits and Systems I
- Reviewer, Journal of Nanotechnology, Institute of Physics Publishing, Dirac House, Temple Back, Bristol, UK
- Reviewer, Journal of Physics D: Applied Physics, Institute of Physics Publishing, Dirac House, Temple Back, Bristol, UK
- Reviewer, Journal of Micromechanics and Microengineering, Institute of Physics Publishing, Dirac House, Temple Back, Bristol, UK

Dr. S. Erfani:

- Member of Steering Committee, IEEE Midwest Symposium on Circuits and Systems
- Technical Advisory Board member, Journal of Network and Systems Management

Dr. R. Rashidzadeh:

- CMC Peer Review Committee Member for the National Design Network
- Reviewer for Massachusetts Institute of Technology (MIT) Press
- Reviewer for IEEE Transactions on Computers
- Reviewer for IEEE transaction on Instrumentation and Measurement
- Reviewer for Journal of Analog Integrated Circuits and Signal Processing
- Reviewer for Journal of Electromagnetic Waves and Applications

IV. SCHOLARY ACTIVITIES AND PUBLICATIONS

Refereed Journal Publications

- G. Deng and C. Chen, "A SET/MOS Hybrid Multiplier Using Frequency Synthesis," *IEEE Transactions on Very Large Scale Integration (VLSI) Systems*, vol. 21, no. 9, September 2013, pp. 1738-1742.
- G. Deng and C. Chen, "Binary Multiplication Using Hybrid MOS and Multigate Single-Electron Transistors," *IEEE Transactions on Very Large Scale Integration (VLSI) Systems*, vol. 21, no. 9, September 2013, pp. 1573-1582.
- A. Baradarani, Q.M.J. Wu, M. Ahmadi " An Efficient Illumination Invariant Face Recognition Framework Via Illumination Enhancement and DD-DTCWT Filtering" *Pattern Recognition Journal*, Vol. 46, Issue 1, Jan. 2013, pp57-72.
- Ibne Basith, N. Kandalaft, R. Rashidzadeh, M. Ahmadi " A Charge Controlled Readout and BIST Circuit for MEMS Sensors" *IEEE Trans. On Computer Aided Design of Integrated Circuits and Systems*, Vol. 32, Issue 3, March 2013, pp 433-441
- N. Kandalaft, R. Rashidzadeh, M.Ahmadi " Testing 3-D IC Through-Silicon-Vias (TSVs) by Direct Probing" *IEEE Trans. On Computer-Aided Design of Integrated Circuits and Systems*, April 2013, Vol. 32, No. 4 pp538-546.
- Zhu Cheng, Zhan Wang, Haitao Liu, M.Ahmadi " On Stepsize of Easy Subspace Tracking Method" *Journal of Communications in Computer and Information Science*, Vol. 337, 2013, pp 253-261.
- Weihong Fan, Majid Ahmadi, Feng Xue " Radio Propagation Characteristics of Indoor Location Systems Based on RSSI at 490 MHz" *Journal of Circuits, Systems and Computers*, Accepted for publication Dec. 2013 (16 pages)
- Singh, Brajendra, K; Coulter, Jeremy; Sayani, Mohammed, A. G.; Sami, Syed, M; Khalid, Mohammed; Tepe, Kemal, "Survey on Communication Architectures for Wind Energy Integration with the Smart Grid", *International Journal of Environmental Studies*, Taylor & Francis Online, 1-12, 2013, August.
- Liao, Junsong; Singh, Brajendra, K; Khalid, Mohammed, A. S.; Tepe, Kemal, E, "FPGA based wireless sensor node with customizable event-driven architecture", *EURASIP Journal on Embedded Systems*, Springer(DOI: 10.1186/1687-3963-2013-5), 2013, April.
- Zamanlooy B., Mirhassani M, "Robust Area-Efficient Mixed-Signal CVNS Madaline", *Journal of Neurocomputing*, 14 Pages, In Press
- Zamanlooy B., Mirhassani M, "CVNS-Based Sigmoid Function Evaluation for Neurochips with On-Chip Learning", *IEEE Transactions on Neural Networks and Learning Systems*, 14 pages, Submitted: Mar-2013, Revision Request: Aug. 2013, Final Submission: Dec. 2013, Reference Number: TNNLS-2013-P-1462

- Zamanlooy B., Mirhassani M, “Efficient VLSI Implementation of Neural Networks With Hyperbolic Tangent Activation Function”, *IEEE Transaction on VLSI*, Vol. 22, No. 1 pp. 39 - 48
- A. Attaran, S. Chowdhury, “Fabrication of a 77 GHz Rotman Lens on a High Resistivity Silicon Wafer Using Lift-Off Process”, *International Journal of Antennas and Propagation*,
- T. Zure, S. Chowdhury, “Effect of Dielectric Charging on Capacitance Change of an SOI Based CMUT”, *Journal of Micro and Nanosystems*, (Accepted).
- M. Rahman, J. Hernandez, , S. Chowdhury, “ An Improved Analytical Method to Design CMUTs with Square Diaphragms”, *IEEE Transactions on Ultrasonics , Ferroelectrics, and Frequency Control*, Vol. 60, no. 4, pp. 834-845, Apr. 2013.
- I.G. Muhammad, E. Abdel-Raheem, and K. Tepe, Blind Adaptive Low-Complexity Time-Domain Equalizer Algorithms for ADSL Systems by Adjacent Lag Auto-correlation Minimization (ALAM), *Digital Signal Processing*, Elsevier, Vol. 23, Issue 5, pp. 1695-1703, Sept. 2013.
- A. C. Karloff and E. Abdel-Raheem, Performance Analysis of a Flexible, Optimized and Fully Configurable FPGA Architecture for Two-Channel Filter Banks, *Int. J. of Computing and Digital Systems*, Vol. 2, No. 2, pp. 53-62, 2013.
- I.G. Muhammad, K. Tepe, and E. Abdel-Raheem, QAM Equalization and Symbol Detection in OFDM Systems using Extreme Learning Machine, *Neural Computing and Applications*, Springer, Vol. 22, Issue (3-4), pp. 91-500, March 2013.

Refereed Conference papers

- Saif Rahman, Yiruo He, Huapeng Wu: Public-Key Based Efficient Key Distribution in Bluetooth. ITNG 2013: 727-728
- Huapeng Wu: Low complexity LFSR based bit-serial montgomery multiplier in GF(2^m). ISCAS 2013: 1962-1965
- R. Rashizadeh, I.I. Basith, “A Test Probe for TSV using Resonant Inductive Coupling for 3D ICs,” 2013, International Test Conference, Anaheim, CA, USA, Sept. 10-12, 2013 (in press).
- P. S. Nagpal, R. Rashidzadeh, “Indoor Positioning using Magnetic Compass and Accelerometer of Smartphones,” International Conference on Selected Topics in Mobile and Wireless Networking (MoWNeT), Montreal, Canada, Aug. 19-21, 2013, pp. 140-145.
- R. Rashizadeh, “Contactless Test Access Mechanism for TSV Based 3D ICs,” 2013, Proceedings of the IEEE VLSI Test Symposium (VTS), Berkeley, CA, USA, April 29-May 2, 2013, pp. 1-6.
- C. Liu and C. Chen, “An Ultra-Low Power Voltage Regulator for RFID Application,” In Proceedings of 2013 IEEE Midwest Symposium on Circuits and Systems (MWSCAS'13), August 2013, Ohio, USA, pp. 780-783.

- R. Xiao and C. Chen, "Single-Electron Tunneling Based Turnstile: Modeling and Applications," In Proceedings of 2013 IEEE International Conference on Nanotechnology (IEEE-Nano'13), August 2013, Beijing, China, pp. 77-82.
- A. Parvin, M.Ahmadi, R. Muscedere " Application of Neural Networks with CSD Coefficients for Human Face Recognition" Proc. of 2013 IEEE-ISCAS, May 19-23, 2013, Beijing, China, pp1628-1631.
- K. Leboeuf, R. Muscedere, M. Ahmadi " A GPU Implementation of the Montgomery Multiplication Algorithm for Elliptic Curve Cryptography" Proc. of 2013 IEEE-ISCAS, May 19-23, 2013, Beijing, China, pp2593-2596.
- J. Alarcon, X. Chen, M. Ahmadi "Re-Configuration Strategy for PTZ Camera Networks" Proc. of the 6th IFAC Symposium on Mechatronic Systems, April 10-12, 2013, Hangzhou, China, pp 563-566.
- S. Erfani, M. Ahmadi, N. Bayan " Analysis of Linear Time Varying Circuits by Two-Dimensional Analog Filtering" Proc. Of 2013 IEEE-Midwest Symposium on Circuits and Systems, Columbus, Ohio, pp750-753.
- F. Awin, E. Abdel-Raheem, M.Ahmadi" On the Impact of Acceleration on the Performance of Mobile Cognitive Radios" " Proc. Of 2013 IEEE-Midwest Symposium on Circuits and Systems, Columbus, Ohio, pp1330-1333.
- A. Elazhari, M. Ahmadi " Interpolation of Low Resolution Images for Improved Accuracy in Human Face Recognition" Proc. Of 2013 IEEE International Conference on Electronics Circuits and Systems, Dec. 2013, Abu-Dhabi, pp. 425-428.
- M. Lalmazloumian, Kuan Yew Wong, M.Ahmadi " A Mathematical Model for Supply Chain Planning in a Build-to-Order Environment" 5th International Conference on Changeable, Agile, Reconfigurable and Virtual Production, 2013, Germany, Springer International Publishing, pp 315-320, DOI: 10.1007/978-3-319-02054-953.
- Imbewa, Abdelrazag; Khalid, Mohammed, A. S., FLNR: a Fast Light-Weight NoC Router for FPGAs, Proceedings of the IEEE 56th International Midwest Symposium on Circuits and Systems, August 2013.
- A. Bakhtazad, R. Manwar, S. Chowdhury, "Cavity Formation in Bonded Silicon Wafers Using Partially cured Dry Etch Bisbenzocyclobutene (BCB)", LASCAS2014, Santiago, Chile.
- J. Hernandez, T. Zure, S. Chowdhury, "Capacitance Measurements of an SOI Based CMUT, Proceedings of IEEE Fourth Latin American Symposium on Circuits and Systems (LASCAS), 2013, Feb. 27-Mar. 1, 2013, Cusco, Peru, pp. 1-4.
- I. Gul-Muhammad, E. Abdel-Raheem, and K. Tepe, "A Configurable Blind Adaptive Low-Complexity Time-Domain Equalizer for ADSL Systems by Auto-correlation Minimization," Proc. IEEE ICCSPA 2013, Sharjah, UAE, Feb. 2013.

Patents

1.	03/14/2013	PCT	S. Chowdhury	Ultrasonic Microarray and the method of manufacturing	PCT/CA2013/000937
2.	04/04/2013	USA Provisional Patent	S. Chowdhury	CMUT based ultrasonic micro array	61/856224
3.	03/13/2013	USA Patent	S. Chowdhury	CMUT based ultrasonic microarray and method of manufacture	13/804279
4.	07/19/2013	USA Provisional Patent	S. Chowdhury, A. Bakhtazad	CMUT, Method of manufacture using BCB	61/856224

V. LIST OF SEMINARS HELD IN 2013

- An algorithm to check roundness of precision gauges**
 Presented by: Rahul Kapoor
 Feb. 15, 2103
- Contactless TSV Probing Using Resonant Inductive Coupling**
 Presented by: Iftekhar Ibne Basith
 Feb. 27, 2103
- Two-Channel Quadrature-Mirror Filter Bank**
 Presented by: Weihong Fan
 Apr. 23, 2103
- A GPU Implementation of the Montgomery Multiplication Algorithm for Elliptic Curve Cryptography**
 Presented by: Karl Leboeuf
 Apr. 24, 2103
- 60GHz Chipless Radio Frequency Identification (RFID) System**
 Presented by: Ail Attaran
 May 24, 2103
- On the Impact of Acceleration on the Performance of Mobile Cognitive Radios**
 Presented by: Farooq Awin
 Jun. 14, 2103
- Radar/IR /Acoustic Bird/Bat Monitoring System for Wind Turbine Applications & Development of Parallel Architectures for Signal Processing Applications**
 Presented by: Professor Mohsin M. Jamali
 Nov. 02, 2103

- **High Level Low Power Design for A Digit Serial Polynomial Basis Finite Field Multiplier in GF(2²³³)**
Presented by: Shoaleh Hashemi Namin
Nov. 22, 2103
- **Test and Measurement Solutions from Electro Rent Corporation and Agilent Technologies**
Presented by: Imtiyaz Wahed
Nov. 23, 2103
- **Chipless RFID Tag**
Presented by: Ali Attaran
Nov. 29, 2103

VI. RESEARCH ACTIVITIES

Dr. S. Erfani

- Computer and Network Security
- Data Networking
- Communication Network Management
- Multidimensional Digital Filter Realization

Dr. M. Mirhassani

- Hardware realization of neural networks
- Alternative computer Arithmetic
- Solid state devices

Dr. M. Ahmadi

- Pattern Recognition
- Computer Arithmetic
- Crypto System Design
- Cognitive Radio
- Indoor Positioning System
- Neural Networks
- Image Processing

Dr. M. Khalid

- Field Programmable Chips and Systems: Architecture, CAD and Applications
- Embedded systems for automotive applications

Dr. R. Muscedere

- Very Large Scale Design
- Computer Arithmetic
- Electronic Design Automation Tools
- Dedicated Mobile Hardware

Dr. C. Chen

- Synthesis and Optimization of Digital Integrated Circuits
- VLSI Computer-Aided Design
- High-Performance Low-Power Systems Design
- Combinatorial Algorithms

Dr. H. Wu

- Implementation of Cryptography Systems
- Computer Network Security

Dr. R. Rashidzadeh

- Mixed-Signal Testing
- Radio Frequency Identification (RFID)
- Integrated Wireless Communication Systems
- Accurate Indoor Positioning for Border Security
- Utilizing RFID for Cancerous Tumor Positioning
- Test and Measurement using Coordinate Measuring Machines

Dr. E. Abdel-Raheem

- Digital Signal Processing
- Signal Processing for Communications
- Spectrum Sensing for Cognitive Radio

Dr. S. Chowdhury

- MEMS tri-mode Radar for automotive collision avoidance
- MEMS ultrasonic Sensor microarray for automotive collision avoidance
- Integrated active safety systems for vehicles
- Ultrasonic transducer for medical diagnostic imaging
- A MEMS Multi-Spectral Transducer Array
- Ultrasonic sensor for biometric identification
- MEMS short range radar for border security

VII. GRANTS AND CONTRACTS RECEIVED BY THE RCIM MEMBERS**Dr. M. Ahmadi**

NSERC-DG	\$51,000
FedDev Security Project	\$17,900
Ford Motor Company and Connect Canada	\$17,815.17
Woodbridge Foam Company and Connect Canada	\$12,000
Kautex-Textron and Connect Canada	\$27,244.80
Total:	\$125,959.97

Dr. M. Khalid

NSERC-DG \$20,000

AUTO21 \$22,800

Total: \$42,800

Dr. C. Chen

NSERC-DG \$18,000

Total: \$18,000

Dr. M. Mirhassani

Secure Car-to-Car Communication \$20,000

OCE-Connect Canada-VistaPrint Inc. \$63,890 (\$44,890cash+\$19,000in-kind)

NSERC Engage \$39000 (\$25,000cash+14,000in-kind)

NSERC Engage \$41,640 (\$25,000cash+16,640in-kind)

NSERC Discovery \$24,000

Total: \$188,530

Dr. S. Chowdhury

MIS Electronics, Toronto \$201,000 (\$102,000 cash+\$99,000in-kind)

Auto21 \$36,550

Border Security Project \$30,100

OCE \$85,000

NSERC-DG \$20,000

Total: \$372,650

Dr. R. Rashidzadeh

Landau Gage Inc., Windsor \$271,320 (105,000cash+166,320in kind)

FedDev Security Project \$17,900

Connect Canada \$31,920

NSERC Engage \$25,000

OCE TPS \$24,995

NSERC DG \$18,000

CMC Fabrication Award \$2,000

Total: \$391,135

Dr. H. Wu

NSERC-DG	\$23,000
Vehicular communication security	\$10,000
Total:	\$33,000

Dr. S. Erfani

FedDev: Project No.802390	\$16,300
Total:	\$16,300

Grants received by RCIM members in 2013: 1,188,734.97

CMC Delivered Value: 1,448,555.00

TOTAL GRANTS IN 2013 \$2,637,292.97

VIII. GRADUATE COURSES TAUGHT BY RCIM MEMBERS

- | | | |
|-----|---------------------|--|
| 1. | Dr. S. Erfani | 06-88-557: Network Security |
| 2. | Dr. S. Erfani | 06-88-590: Secure Electronic Commerce |
| 3. | Dr. M. Ahmadi | 06-88-521: Digital Signal Processing |
| 4. | Dr. E. Abdel-Raheem | 06-88-551: Advanced Digital Signal Processing |
| 5. | Dr. M. Khalid | 06-88-560: Reconfigurable Computing |
| 6. | Dr. R. Muscedere | 06-88-531: VLSI Design |
| 7. | Dr. C. Chen | 06-88-541: Low Power CMOS Design |
| 8. | Dr. C. Chen | 06-88-565: Introduction to Nanoelectronic Design |
| 9. | Dr. H. Wu | 06-88-555: Computer Arithmetic |
| 10. | Dr. H. Wu | 06-88-566: Data Security and Cryptography |
| 11. | Dr. S. Chowdhury | 06-88-552: Advanced Topics in MEMS |
| 12. | Dr. M. Mirhassani | 06-88-590-64 Solid State Devices |
| 13. | Dr. Rashidzadeh | 06-88-590-37: Advanced Analog Circuit Design |
| 14. | Dr. Rashidzadeh | 06-88-590-74: RF Integrated Circuit Design |

IX. COLLABORATIVE RESEARCH WITH THE PRIVATE SECTOR

Dr. S. Chowdhury

- MIS Electronics, Toronto

Dr. M. Ahmadi

- Ford Motor Company
- Woodbridge Foam Company
- Kautex-Textron Company

Dr. M. Mirhassani

- Vistaprint Inc.
- Waltron Trailers Inc

Dr. R. Rashidzadeh

- Landau Gage Inc.
- ArciTrax Inc.

INVITED TALKS

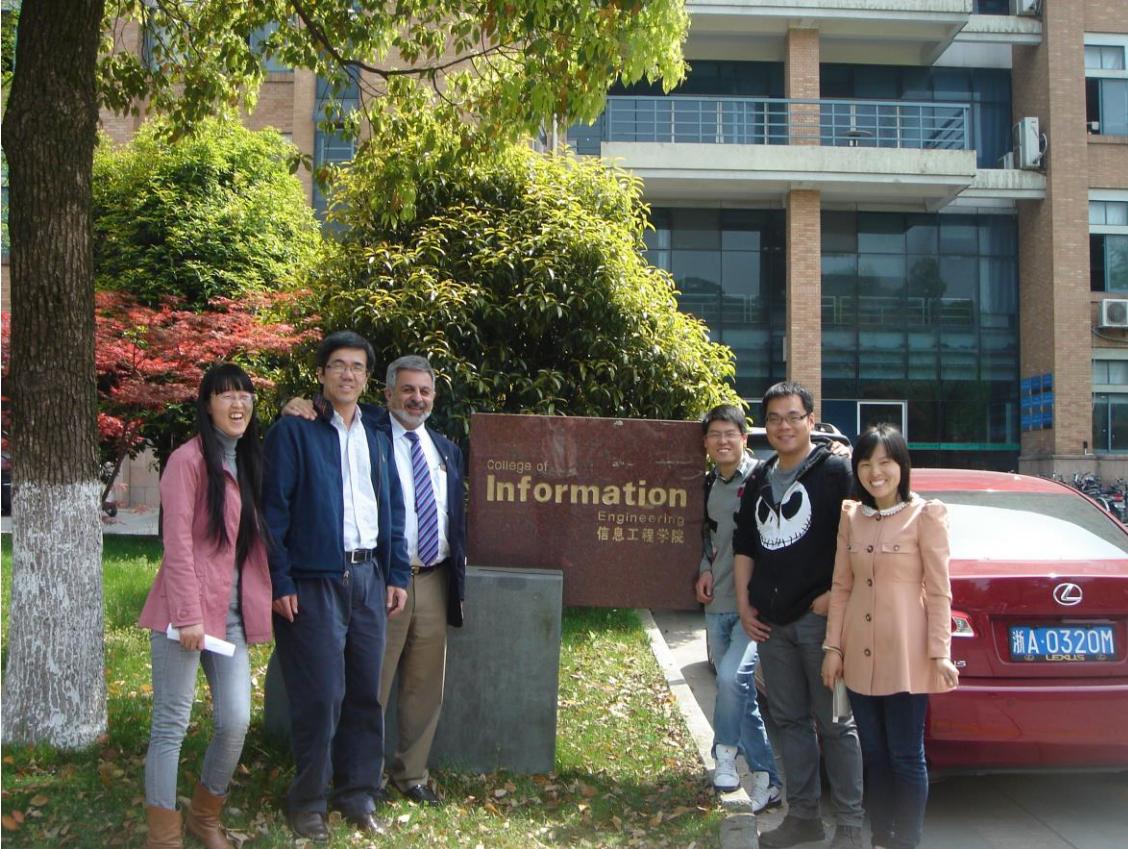
Dr. Abdel-Raheem

- ❖ On Signal Processing Algorithms and Implementations for Cognitive Radio, **Ain Shams University**, Cairo, **Egypt**, Feb. 16th, 2013.
- ❖ Centre of Engineering Innovation (CEI) at the University of Windsor, **Ain Shams University**, Cairo, **Egypt**, Feb. 16th, 2013.
- ❖ On Signal Processing Algorithms and Implementations for Cognitive Radio, **The Petroleum Institute**, Abu Dhabi, **UAE**, Feb. 11th, 2013.
- ❖ Centre of Engineering Innovation (CEI) at the University of Windsor, **The Petroleum Institute**, Abu Dhabi, **UAE**, Feb. 11th, 2013.

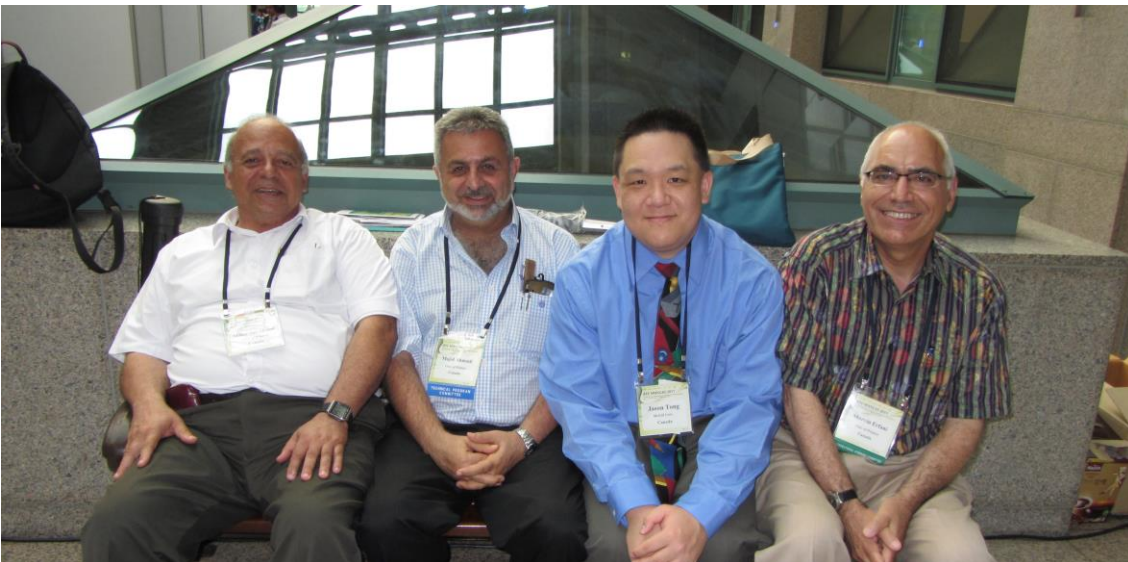
Dr. M. Khalid

"FPGA-based Custom Computing Machines: Extending the Frontiers of Computing", Professor KK Nair commemoration lecture, from 12-20 PM to 1-20 PM on Sunday 29th December, 2013 at ECE Department Auditorium, Osmania University College of Engineering, Hyderabad, India.

I. PHOTOGRAPHS



Visiting of Zhejiang University of Technology, Hong Zhou, China
Dr. X. Cheng (second from left) and Dr. M. Ahmadi (third from left) and
Dr. Yu Feng (second from right) with graduate students.



Electrical Engineering Conference Seoul Korea
Left to right: Dr. M. Sid-Ahmed, Dr. M. Ahmadi, Mr. J. Tong, Dr. S. Erfani.



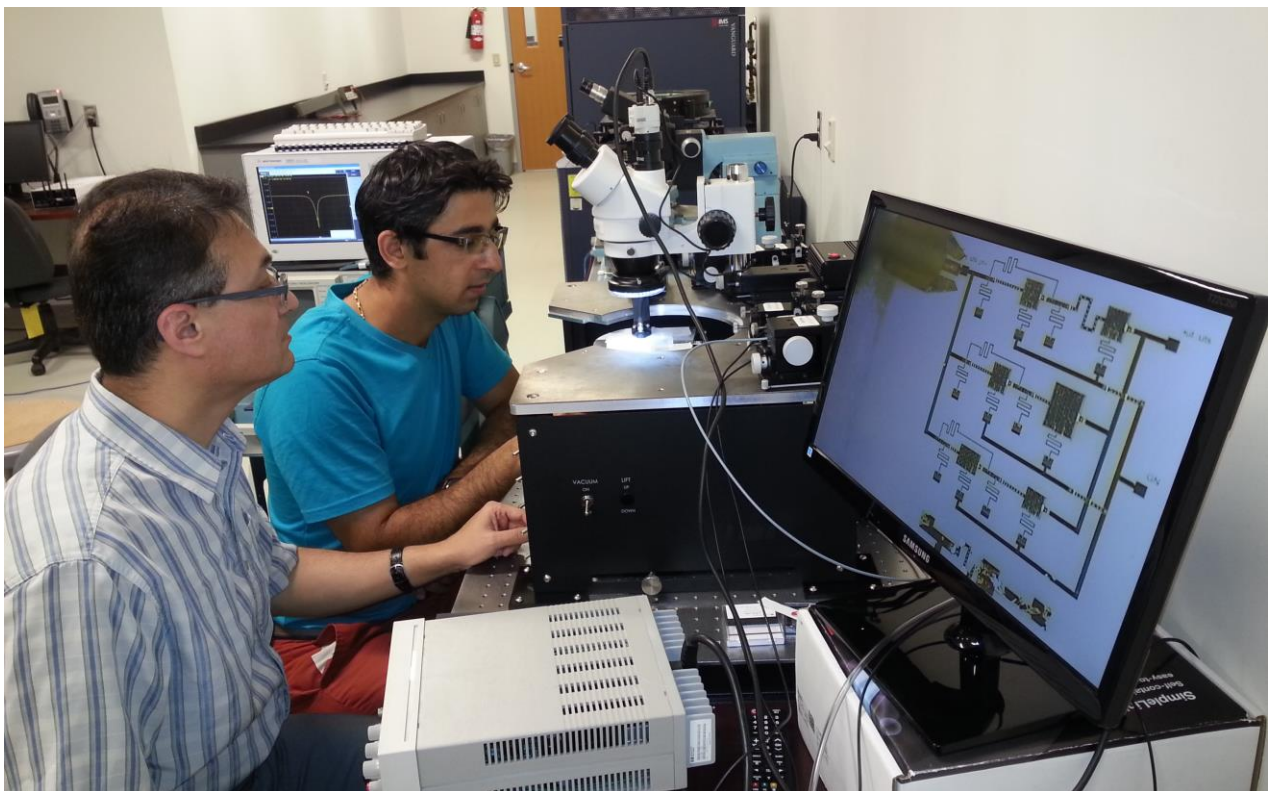
Ph.D Defense Seminar-Left to right Dr. Majid Ahmad, Dr. Paul Henshaw, Mr. Babak Zamanlooy (Ph.D. Candidate), Dr. Mitra Mirhassani and Dr. Alex Yi.



International Symposium on Signals, Circuits and Systems 2013-Romania
Organization Committee-Technical Program Chair- Dr. M. Ahmadi (Second from Right)



RCIM indoor positioning research team presenting their work at the Windsor Essex Tech Show. Left to right: Mr. Paramir Singh Nagpal, master student, Dr. Rashid Rashidzadeh and Mr. Esrafil Jedari Sefidgari, Ph.D. candidate.



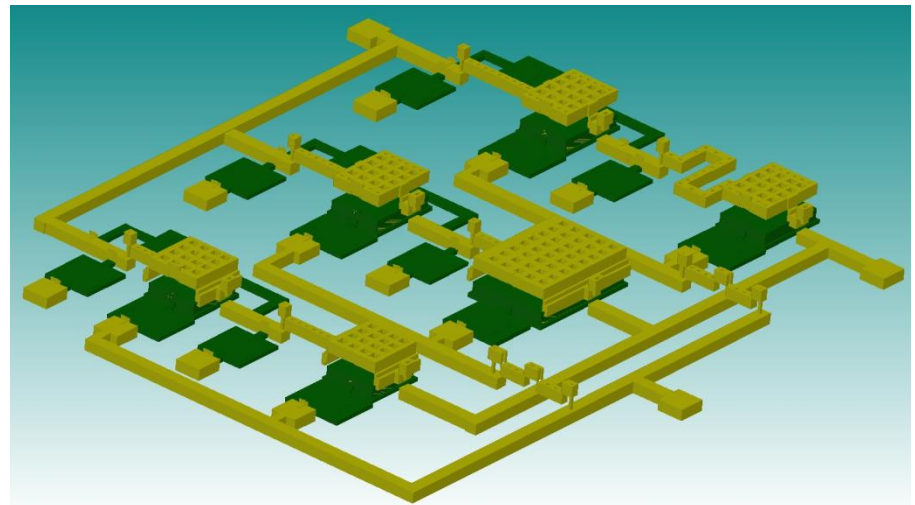
Dr. Rashid Rashidzadeh (left) and Mr. Ali Attaran (Ph.D. candidate) testing a MEMS based chipless RFID tag.

Chipless Radio Frequency Identification (RFID) System

Ali Attaran, Ph.D. Candidate

Supervisors: Dr. R. Rashidzadeh and Dr. R. Muscedere

A novel chipless radio-frequency identification (RFID) tag using micro-electro-mechanical systems (MEMS) technology is designed, simulated, fabricated. The tag can operate at the conventional UHF band as well as microwave range (60GHz) for RFID applications and it is implemented using a basic fabrication process. In the presented scheme, MEMS switches are used as programmable elements to support communication between the tag and RFID interrogators. The removal of the chip allows the tag price to fall enough to become an alternative to barcode labels.



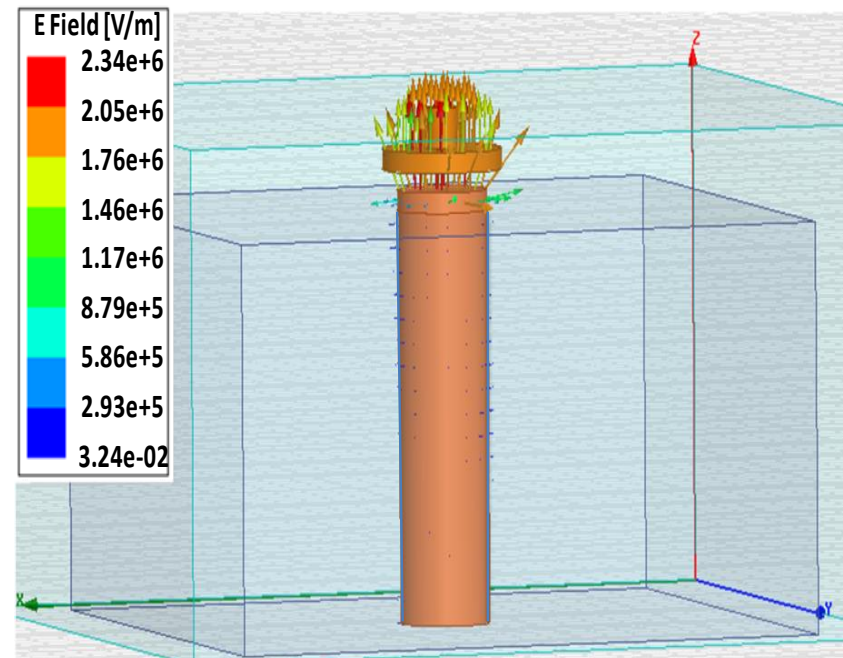
3D view of the implemented MEMS switching modules for a 3-bit chipless tag.

Contactless Test Access Mechanism using Capacitive Coupling for TSV Based 3D ICs

Iftekhar Ibne Basith, Ph.D. Candidate

Supervisors: Dr. R. Rashidzadeh and Dr. E. Abdel-Raheem

It is clear that the new generation of integrated circuits take the advantages of stacking multiple layers of circuits and interconnects to reduce the costs and save the area. This new approach toward circuit integration will require new techniques for circuit probing and pre-package testing. Current wafer level touch probes cannot be readily utilized to probe thinned wafers or layers of monolithic 3D ICs. The physical integrity of thinned wafers or IC layers can be undermined by conventional wafer probing. In this work a microscale probe will be designed and used as a contactless probe for TSV.



3D view of the proposed contactless probe and TSV in HFSS environment.

Mixed-Signal VLSI Implementation of CVNS Artificial Neural Networks

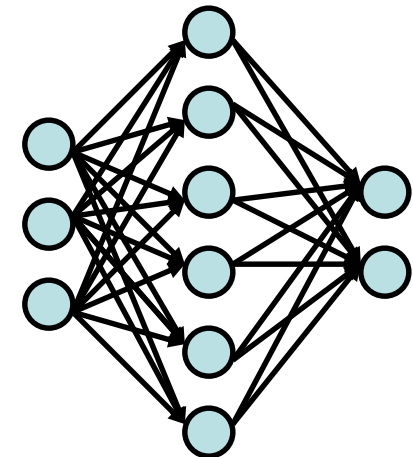
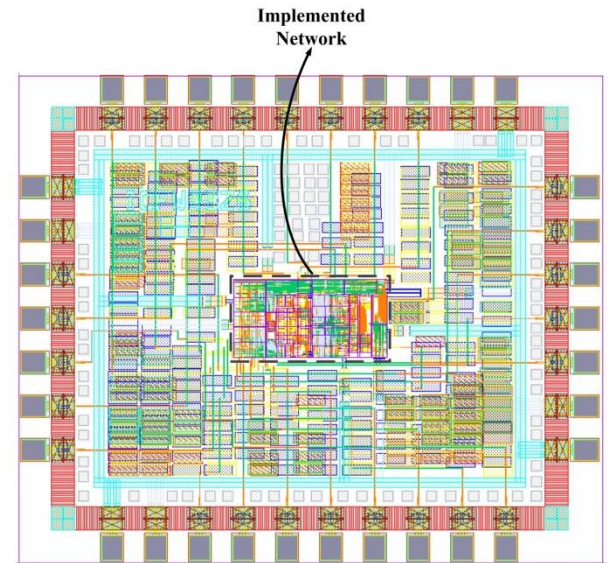
Babak Zamanlooy, Ph.D.
Supervisor: Dr. M. Mirhassani

VLSI implementation of neural networks has been exploited in various applications. Examples include pattern recognition, test of analog circuits, real-time surface discrimination and smart sensing.

In this work, mixed-signal VLSI implementation of Continuous Valued Number System (CVNS) neural networks is proposed. The proposed network resolves the limited signal processing precision issue present in mixed-signal neural networks. Layout of the 2-2-1 mixed-signal CVNS network sent for fabrication is shown on the right.

In addition, an area-efficient low sensitivity CVNS Madaline is proposed. The proposed Madaline is more robust to input and weight errors when compared to the previously developed structures. Moreover, its area consumption is lower.

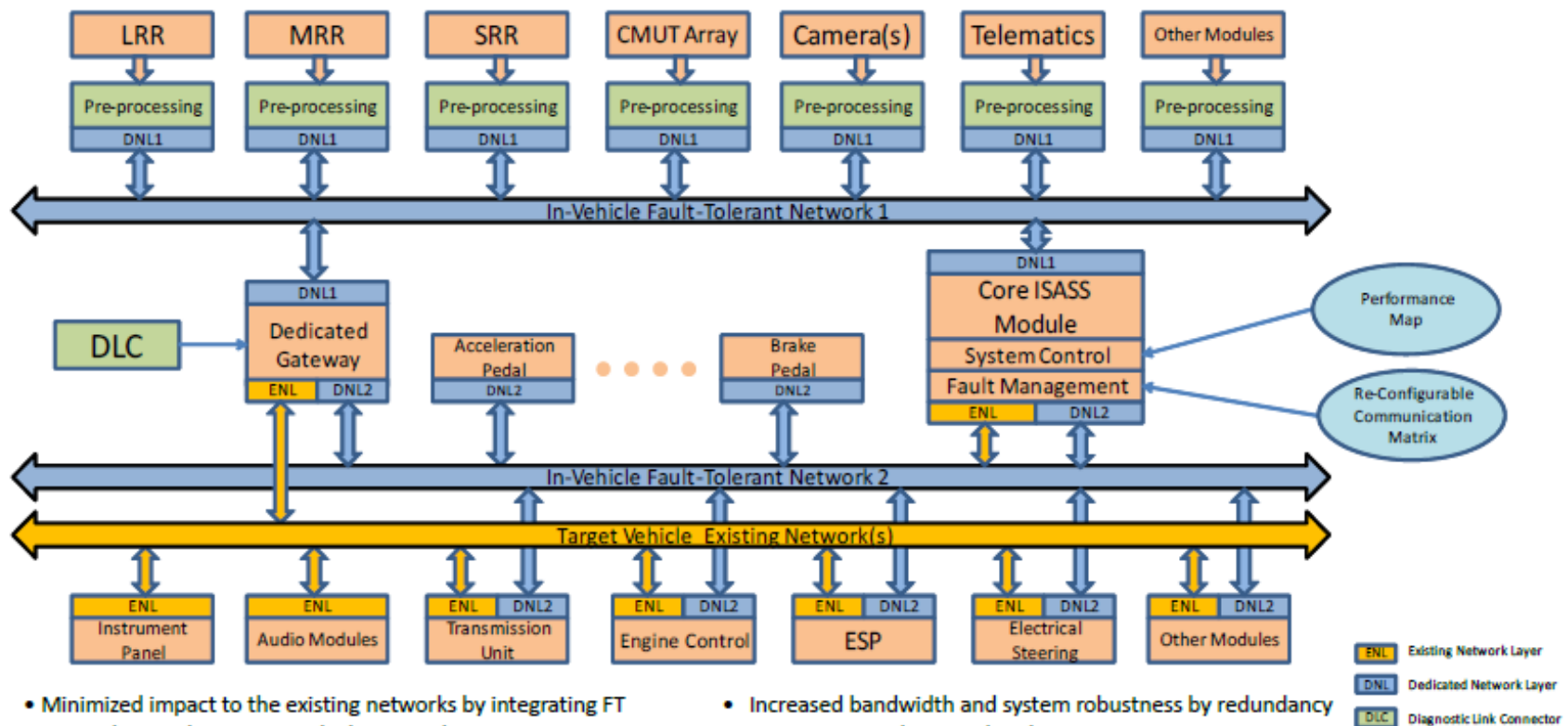
Furthermore, a new approximation scheme for hyperbolic tangent activation function is proposed. Using the proposed approximation scheme results in efficient implementation of digital ASIC neural networks in terms of area, delay and power consumption.



A Fault-Tolerant Vehicle Network for Safety Critical Subsystems

Weiyang Zeng: PhD student
Supervisor: Dr. S. Chowdhury

High Level System Architecture



- Minimized impact to the existing networks by integrating FT network onto the existing vehicle networks
- FT nodes are able to switch simultaneously to the other FT network if one network fails. This feature is led by ISASS module and cooperated by other FT nodes

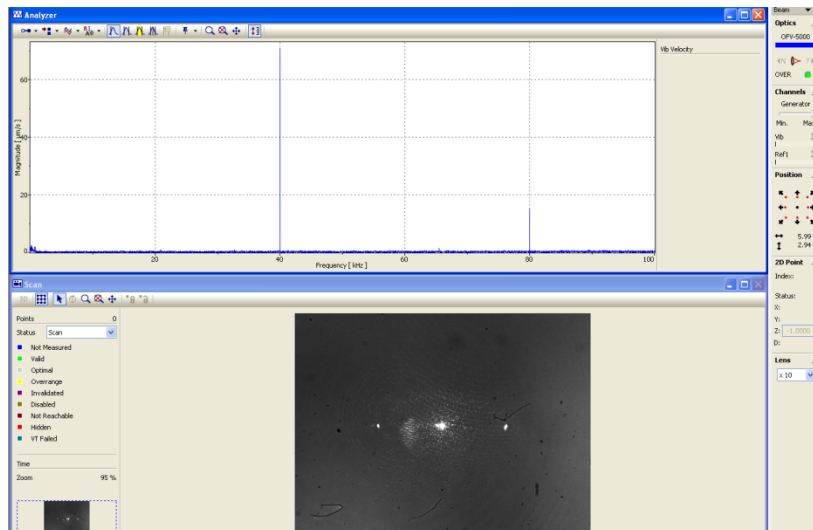
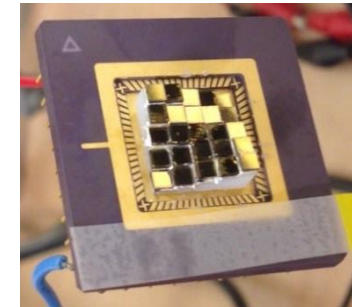
- Increased bandwidth and system robustness by redundancy
- ISASS commands override other sources in emergency
- System is flexible and able to be customized based on different driving styles

MEMS Ultrasonic Sensor Array for Park Assist

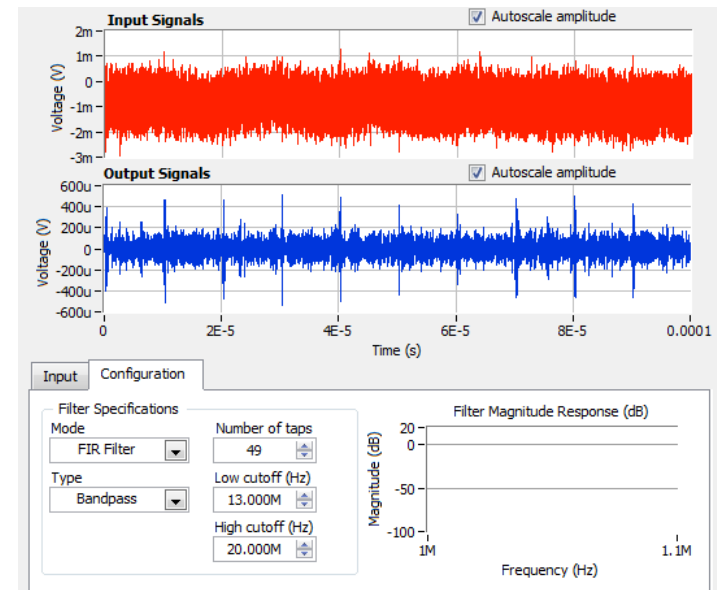
Rayyan Manwar: PhD student

Supervisor: Dr. S. Chowdhury

- A new long range wider angle ultrasonic sensor array has been designed and fabricated for automotive park assist applications



Polytec laser Doppler Vibrometer results showing velocity of the CMUT diaphragm at 40 kHz



Pitch-Catch mode Received pulses in LabView

A Robust RSSI Based System for Indoor Location Positioning

Shaeera Rabbanee Shuvra, M.A.Sc. Student
Supervisor: Dr. M. Ahmadi, Dr. R. Rashidzadeh

There are various localization systems such as global positioning system (GPS) that are available for outdoor spaces. Indoor environments are more complex, because line-of-sight transmission between receivers and sources is not possible in an indoor environment. Several types of wireless technologies, such as Ultra-Wide Band (UWB), Bluetooth, Radio Frequency Identification (RFID) and Wireless Local Area Network (WLAN) are used for indoor localization. Exploiting the Received Signal Strengths (RSS) from the available WLAN systems has been more popular in recent years.



This work introduces new algorithms and hardware implementations for a robust RSSI based indoor positioning system which is expected to give much better speed performance while keeping the accuracy to an expected level.

Low Power Finite Field Multiplication with Wireless Security Applications

Shoaleh Hashemi Namin, Ph.D. Student
Supervisors: Dr. M. Ahmadi, Dr. H. Wu

Wireless data security and power and energy efficiencies are two important issues in many portable devices. Elliptic curve (EC) cryptosystem is an attractive cryptographic system that provides security for battery-based and mobile devices. Therefore, a power or energy efficient elliptic curve system is essential for those portable and resource constraint devices. In this work, several existing digit-serial finite field multipliers, which are used as a main building block in realization of an EC cryptosystem, have been implemented using static CMOS standard cell libraries. Their average power consumption and energy efficiencies for different digit sizes have been evaluated using an accurate power estimation flow. The comparison results obtained in this work are expected to be useful for those who design and/or implement elliptic curve cryptosystem for wireless and portable systems. A power estimation and optimization flow using popular CAD tools, that can be used for power estimation and optimization of digital designs, has also been developed. This work also presents a low power design of a digit-serial finite field multiplier.

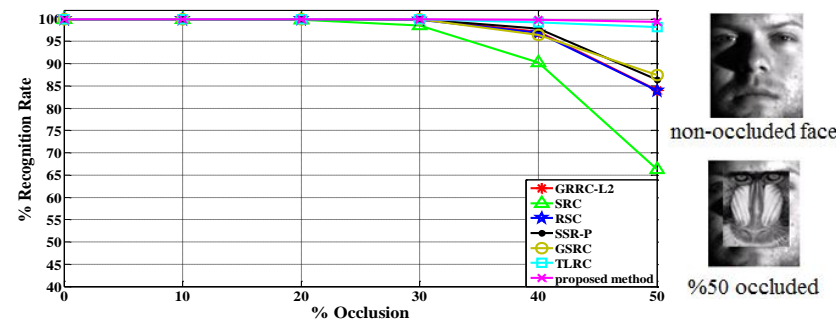
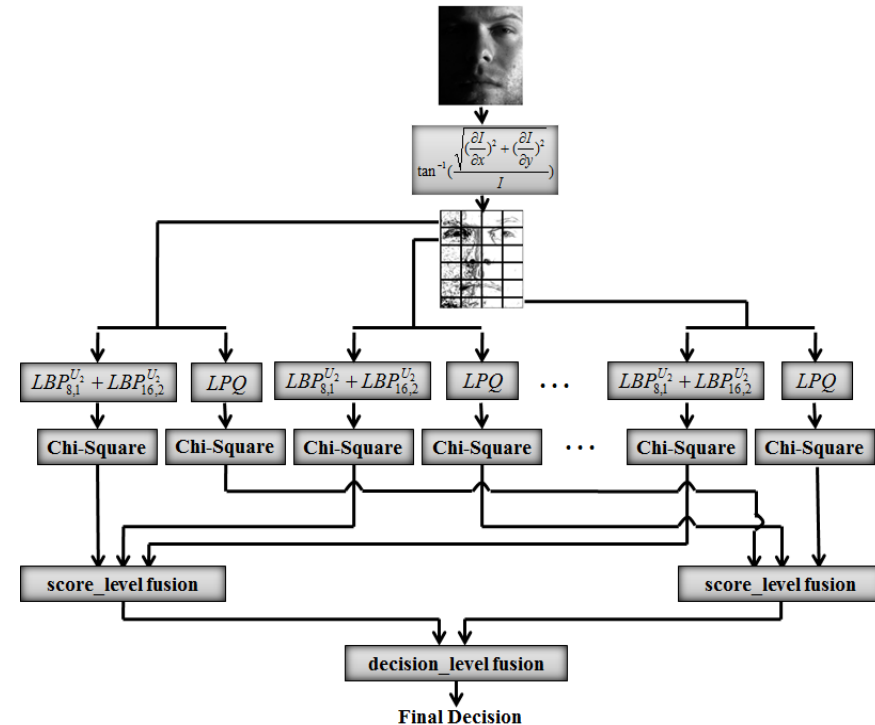


Human Face Recognition under Degradation Conditions

Soodeh Nikan, Ph.D. Candidate

Supervisor: Dr. M. Ahmadi

Face recognition as a biometric identification method has a wide range of applications such as law enforcement and video surveillance. Image degradation due to illumination variation, partial occlusion, and facial expression reduces the identification accuracy substantially. In the proposed algorithm an illumination insensitive image representation is obtained based on the ratio of gradient amplitude to the original image intensity. Local phase quantization (LPQ) and multi-scale local binary pattern (LBP), extract the features of image sub blocks. Distance measurements of local classifiers are fused at score level to find the best match and decision-level fusion combines the local results. Entropy, class posterior probability and mutual information are utilized as the weights of fusion components. Simulation results show the improved performance of the proposed technique with low computational complexity and no reconstruction or training requirement.

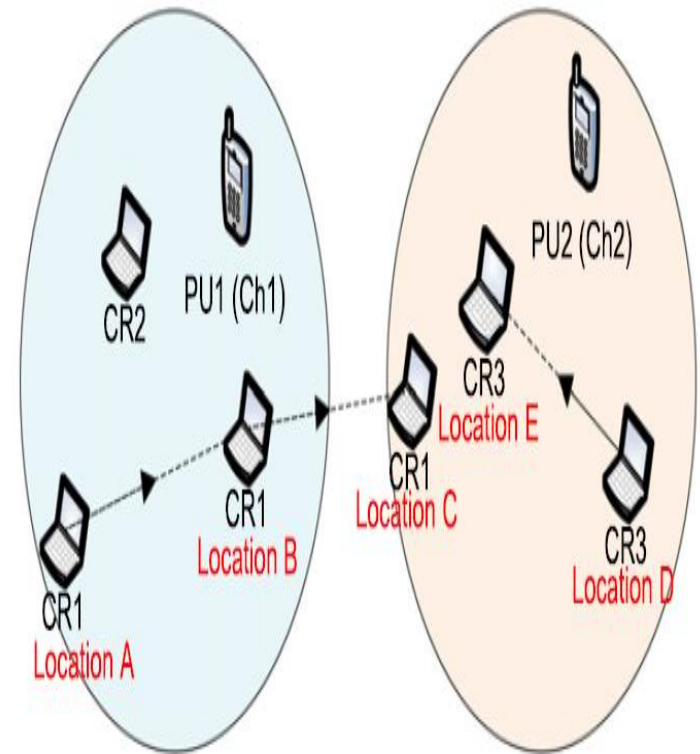


An Efficient and Improved Cooperative Spectrum Sensing for Cognitive Radio Systems

Faroq Ali Awin, Ph.D.

Supervisor: Dr. E. Abdel-Raheem and Dr. M. Ahmadi

Cognitive Radio (CR) technology recently has appeared as a promising solution to frequency scarcity. Weak received signal, noise uncertainty, and fading conditions have an adverse impact of the performance of a single CR, the matter leads to implement the principle of collaboration between a group of CRs. The collaboration greatly improves the performance, however it incurs sensing overhead. Trade off between performance and overhead is a key design factor of CR networks. In our work, we proposed a new technique to perform the collaboration based on dividing the CRs in clusters, groups and subgroups and then combining their observations using two different fusion rules in different hierarchical levels. Mobility, as essential characteristic of wireless communication system, is also considered in our work.



High Level Synthesis for FPGAs using OpenCL

Qing Yun Tang MASc.

Ian Janik MASc.

Supervisor: Dr. M. Khalid

Field Programmable Gate Arrays, or FPGAs, provide the speed up of dedicated hardware with the flexibility of a general purpose processor. The conventional way to design using FPGAs is through hardware description languages (HDLs) such as VHDL or Verilog. The CAD tools that map these HDL level designs to the FPGA hardware are very mature and optimized, but writing the code is tedious work. High level synthesis (HLS) allows the specification of the FPGA design to be written in a high level language, such as OpenCL, which allows a dramatic improvement in design time. The Altera SDK for OpenCL is the HLS tool used to run FPGA accelerated programs on host computers. These accelerated programs can operate in orders of magnitudes faster than CPU systems. Current application targets include the finite-difference time-domain method and elliptic curve cryptography.

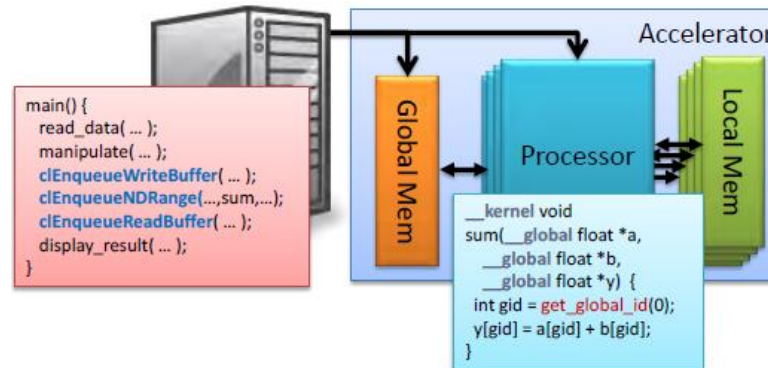


Image courtesy of Altera Corporation,

<http://www.altera.com/products/software/opencl/ieee-cp-information-filtering.pdf>

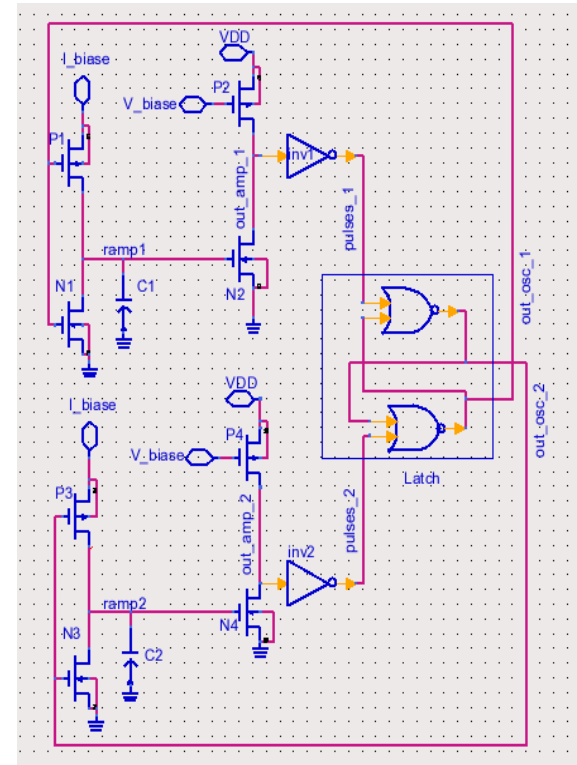
A Temperature Compensated Relaxation Oscillator

Iman Taha, Ph.D.

Supervisor: Dr. M. Mirhassani

A high reliable relaxation oscillator can replace a quartz crystal oscillator if it is designed as temperature and supply independent with digital trimming to counterbalance process variation. Since the quartz crystal oscillators cannot be integrated within a chip, A CMOS realization of a reliable oscillator reduces the size and the cost for system-on-chip (SoC) implementations. Temperature compensated relaxation oscillators are used for various one-chip applications such as biomedical sensors, micro-controllers and high speed interfaces such as HDMI, and SoCs. The frequency of the conventional relaxation oscillator is sensitive to the comparator delay, and non-ideality of the current and voltage references

In this work, a reliable and temperature compensated relaxing. oscillator is designed. The frequency of oscillation is mainly a function of a temperature and supply independent biasing current, while process variation can be compensated through a 3 bit digital control circuitry. The frequency of oscillation can be chosen from a wide linear frequency range after eliminating the comparator delay factor.



Low POWER Hardware acceleration of Text PLACEMENT

Soheil Servati Beiragh, PhD Student
Supervisor: Dr. R. Muscedere

Web browsers and e-book are some of the most dominant applications on mobile devices today; they spend a significant amount of time handling the layout design of text. Many efforts have been made in software to improve the performance of text layout and display but very few have considered dedicated parallel processing hardware schemes for System-On-Chip (SOC) devices. This project researches a new hardware-software hybrid algorithm to perform the layout of proportional text by using a small hardware module which can easily be added to the SOC's of today's mobile devices. The performance of the module is compared to WebKit, the most widely used web rendering framework, and has shown up to 40X performance increases in layout design.

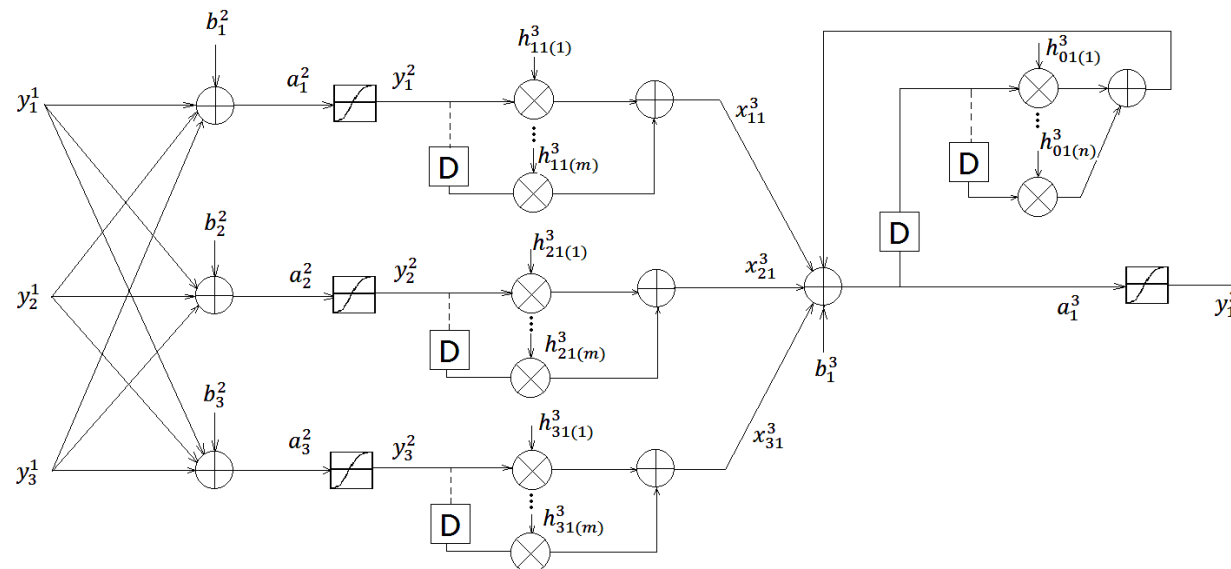


An Efficient Implementation of Local Recurrent Neural Network Based on FPGA

Yuan Jing

Supervisor: Dr. M. Mirhassani

Implementation of a local recurrent neural network is the focus of this research. The structure is similar to a three-layer feed-forward network, but it requires feedback. Moreover, this type of structure is more stable than a fully recurrent network. To increase the efficiency of implementation, FIR synapses are used in the output. A modified version of standard back-propagation algorithm will be used to train the neural network. Efficient implementation of FIR filters using modified range addressable look up tables will be the focus of this research.



Integrated Insect Vision-Based Motion Detector

Bahar Youssefi, Ph.D. candidate
Supervisor: Dr. M. Mirhassani

The proposed system is capable to detecting motion which uses insect visual system. While insect's visual system is relatively simple, it is capable of performing very complex tasks. The visual system has a highly parallel structure with small interaction with neighboring nodes which makes it a good choice for VLSI implementation and real-time process. The architecture contains of four main layers.

Structures which model Insect visual system are similar or derived from Reichardt detector which basically has two branches of delay- and compare elements. In fact, motion is detected by interaction between nearest neighbors.

